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Linking landscape features of urban parks to visitors' sense of place: A novel hybrid machine learning approach

將城市公園的景觀特征與遊客的地方感聯系起來：一種新穎的混合機器學習方法

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▶ ABSTRACT

Sense of place is an essential aspect that enhances people's willingness to revisit, satisfaction and loyalty. Many scholars have conducted research on people's sense of place in public open spaces. However, limited attention has been given to the comprehensive exploration of the physical environmental factors that these studies suggest affect the sense of place. Moreover, the limitations of existing traditional methods and big data approaches remain unresolved. This study aims to investigate the relationship between the physical environmental factors and tourists' sense of place, drawing on dual-function parks in Shanghai as an empirical case study. Natural language processing (NLP) and grounded theory techniques were used to establish a framework for a corresponding sense of place and its associated environmental factors in urban parks via online reviews, and word banks were created to quantify the sense of place. Regression analysis was used to determine the relationship between the sense of place, positive sentiments and environmental factors. The results showed that there was a significant relationship between the positive sentiments of park visitors and many elements of the sense of place. Among environmental factors, 12 factors were found to significantly influence the strength of sense of place. This study contributes to expanding the conceptual framework of sense of place and introducing a new approach to investigate the relationship between environmental factors and tourists' sense of place, and proposing implications for park planning and design.

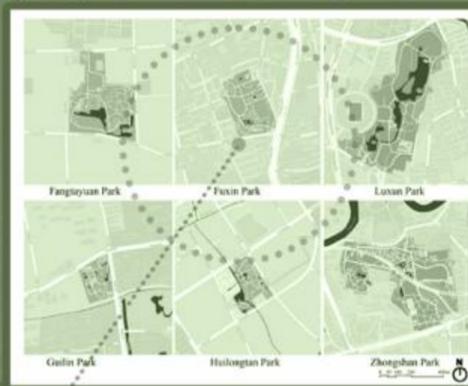**Keywords** Urban parks; Sense of place; Natural language processing; Toursit online reviews; Machine learning

Introduction

This study aims to investigate the relationship among the environmental factors of parks, tourists' sense of place, and positive sentiments, focusing on dual-function parks in Shanghai as a case study. Specifically, this study pursues two main objectives: First, it seeks a novel method to quantify the sense of place through online review data, and to further explore this abstract and vague concept in greater depth. The complex structure of the sense of place and its associated physical environmental factors is determined using grounded theory techniques and NLP tools for constructing word banks. A sense of place index (SOPI) is calculated based on the word frequency and used as a standard to measure sense of place. Second, using regression models, it primarily investigates the relationship between physical environmental factors and the sense of place, as well as how the sense of place affects positive sentiments. This study further expands the conceptual framework of sense of place and its associated physical environmental factors in urban parks, introduces new methodologies for sense of place research, and proposes implications for park planning and design.
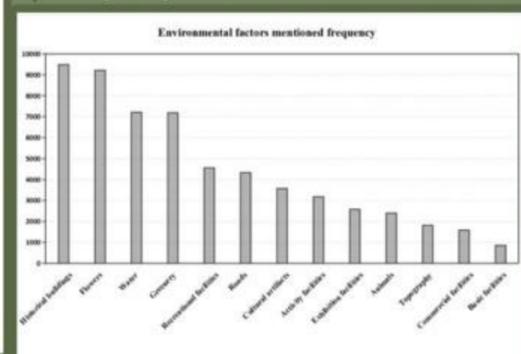
Research design and methodology

The data collection process in this study includes review collection, review filtering, word bank integration (using grounded theory techniques and NLP), and sentiment analysis of each review. For data analysis, Beta regression and logistic regression were used to determine the relationships among sense of place, positive sentiment, and environmental factors. Fig. 1 illustrates the design flow of this study, providing a comprehensive overview of the methodology.

▶ Research design flowchart

The process of open coding, axial coding and final induction related to sense of place and environmental factors

Data collection

This study used six dual-function parks in the statistical list of the Shanghai Landscaping & City Appearance Administrative Bureau (https://lhsr.sh.gov.cn/) as case studies.

▼ Maps of six dual-function parks.

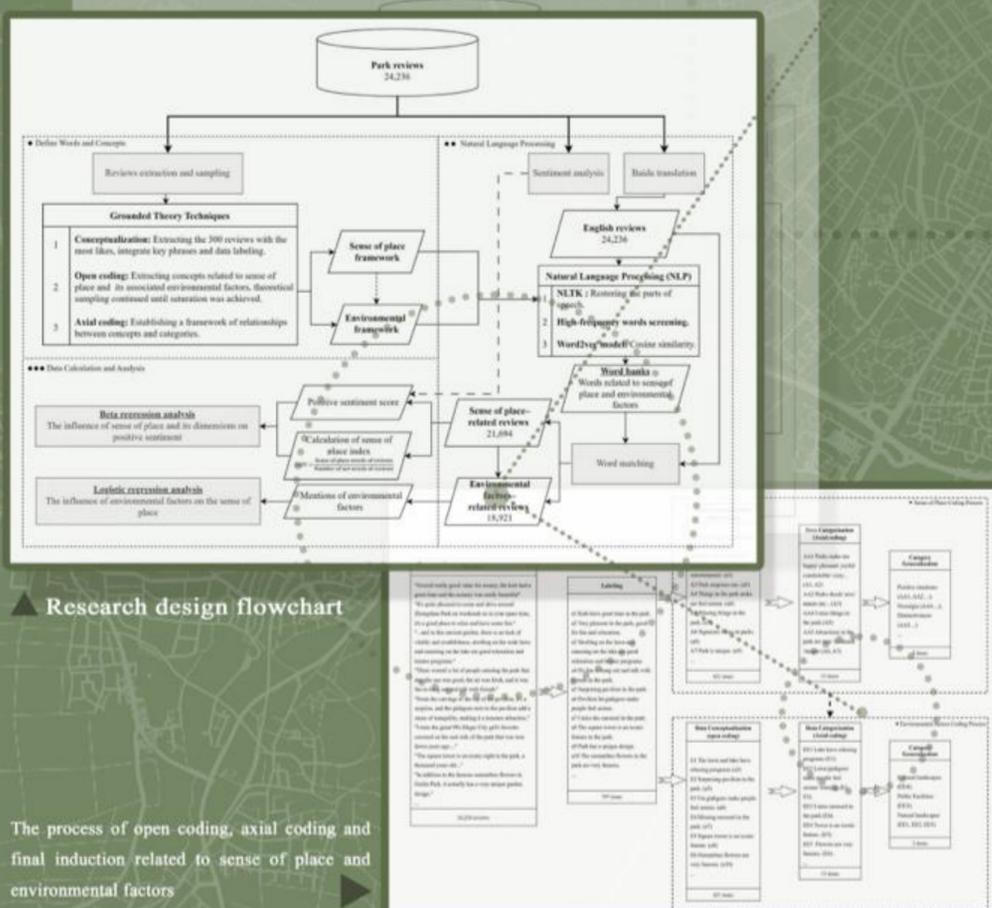▼ Frequency of environmental factors.

Results

The frequency of reviews mentioning environmental factors shows the perceived importance of each park factor. In the context of dual-function parks, visitors mention historical buildings most frequently, followed by aspects that are related to the natural environment, such as flowers, water, and greenery. These factors are widely regarded as integral components of the park experience.

The regression model shows that most of the environmental categories have a significant association with the sense of place. The three main facets have a significant positive relationship with the sense of place. With the exception of E_4 (basic facilities), which shows no significant association with SOPI ($p > 0.05$), all other environmental factors have a significant positive relationship with SOPI ($p < 0.05$ for E_9, $p < 0.01$ for E_2, and $p < 0.001$ for the rest).

The coefficient of the independent variable represents the estimated increase in the log odds of the response variable for each unit increase in its value. The results indicate that among the three main dimensions, public facilities exert the strongest influence on the sense of place, followed by the natural and cultural landscapes. Among the 13 environmental factors, exhibition facilities and commercial facilities have a stronger impact on the sense of place, whereas water bodies exert only a weak influence. The results also find that topography has a greater impact on the sense of place than any other natural environmental factor. This suggests that large natural environmental factors (forests, mountains, etc.) are more effective in enhancing people's sense of place than smaller or man-made landscape elements (flowers, trees, pools, etc.).

Discussion and conclusions

Central to our contribution is the development of a detailed online sense-of-place concept model that transcends the traditional interpretation of sense of place measurement. By integrating grounded theory techniques with big data algorithms, the study examines the interplay among environmental factors, positive sentiments, and sense of place. The findings demonstrate that environmental factors are significantly associated with stronger sense of place and positive sentiments. This innovative study can advance the application of big data and machine learning in the field of sense of place, offering substantial theoretical contributions to broader urban tourism research through a novel dual-driven methodological framework.